GEOLOGIC MAPPING INVESTIGATIONS OF ALBA MONS, MARS. David A. Crown[1], Daniel C. Berman[1], Stephen P. Scheidt[2], and Ernst Hauber[3], [1]Planetary Science Institute, 1700 E. Ft. Lowell Rd., Suite 106, Tucson, Arizona 85719 (crown@psi.edu); [2]Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona 85721; [3]Institute of Planetary Research, German Aerospace Center, Berlin, Germany.

Introduction: This study is designed to provide new constraints on the volcanic history and geologic evolution of Alba Mons. We are using imaging and topographic datasets to produce 1:1M-scale geologic maps of the summit region (245-255°E, 32.5-47.5°N) and western flank (230-245°E, 37.5-47.5°N). Age constraints for volcanic, tectonic, and erosional processes are being derived from detailed mapping of cross-cutting relationships combined with compilation and assessment of crater size-frequency distributions.

Background: Alba Mons is a large, low-relief volcano (1015 × 1150 km in planform; ~6 km relief) with low flank slopes (~1°) [e.g., 1-5]. Studies using Viking Orbiter images described the summit caldera complex, extensive lava flow fields, and prominent sets of circumferential graben [6-15]. Diversity in Alba Mons' lava flows was recognized in Viking Orbiter images, with a series of different morphologies described [6-7, 14-15]. Dendritic valley networks are observed on Alba Mons' northern flank [8, 16-19].

Data Sets and Mapping Methodology: Geologic mapping utilizes THEMIS, HRSC, CTX, and HiRISE images supported by HRSC and MOLA topography. GIS software and analysis tools are being used for the production of digital and hard copy USGS map products. The map bases includes 12 1:500,000-scale Mars Transverse Mercator (MTM) quadrangles.

Geologic Mapping Results: Mapping to-date [20-24] has utilized THEMIS IR and CTX data and includes: 1) Preliminary mapping of geologic features and examination of cross-cutting relationships in the summit region; 2) Systematic mapping of valleys (of likely fluvial origin) across both map areas; and 3) Systematic mapping of geologic features (volcanic, fluvial, tectonic, and impact) throughout the western flank map area. In addition, MOLA topographic datasets (DEM, slope maps with various baselines, and derived curvature statistics) are being integrated into mapping analyses to enhance topographic aspects of geologic features (lava tubes, valleys) whose primary morphologic/textural characteristics may be obscured by surface degradation.

Compilation of digitial map layers that show the distribution of and interactions between volcanic, tectonic, erosional, and impact features have thus far yielded the following results regarding the geology of Alba Mons:

1) Mapping of erosional valleys indicates extensive degradration of the northern and western flanks of Alba Mons [22]. Elongate drainage systems (with lengths of 300+ km) have dendritic to parallel morphologies. The correlation between valley distribution and local slope, and the occurrence of dendritic networks on the highest local slopes, suggest control by topography rather than variations in substrate properties [22].

2) The western flank of Alba Mons is dominated by numerous lava flows and lava tube systems. Their distribution is consistent with the broad shape of the volcano and local slopes (i.e., at 50 km scale), although flow paths have been deflected by local obstacles, including pre-existing craters and volcanic flows. Although local relationships are complex, lava flows generally seem to post-date adjacent lava tube systems.

3) Individual lava flows are typically elongate with relatively constant widths, although width variations, branching, and broader lobes are observed. Typical flow widths are ~2-10 km and numerous flow lobes extend for 100+ km in length. Lava tube systems can extend for 100s of km, are typically discontinuous, and are delineated by sinuous chains of elongate depressions, which in many cases are located along the crests of prominent sinuous ridges.

4) Cross-cutting relationships show that tectonic deformation post-dates volcanic and fluvial activity in the map area. Fluvial valleys dissect volcanic flanks materials, including specific lava flow surfaces, and frequently follow flow margins. Limited examples of lava flows embaying drainage systems are also evident. Mapped ejecta blankets superpose lava flows in some locations, and craters are observed to both truncate and be dissected by valley segments.

5) Preliminary age constraints from crater size-frequency distributions indicate a large pulse of volcanic activity across the western flank of Alba Mons between ~1.1 and 1.5 Ga. Our database of 12,000+ impact craters with diameters between 250 m and 18.3 km will be used for deriving relative and absolute ages.

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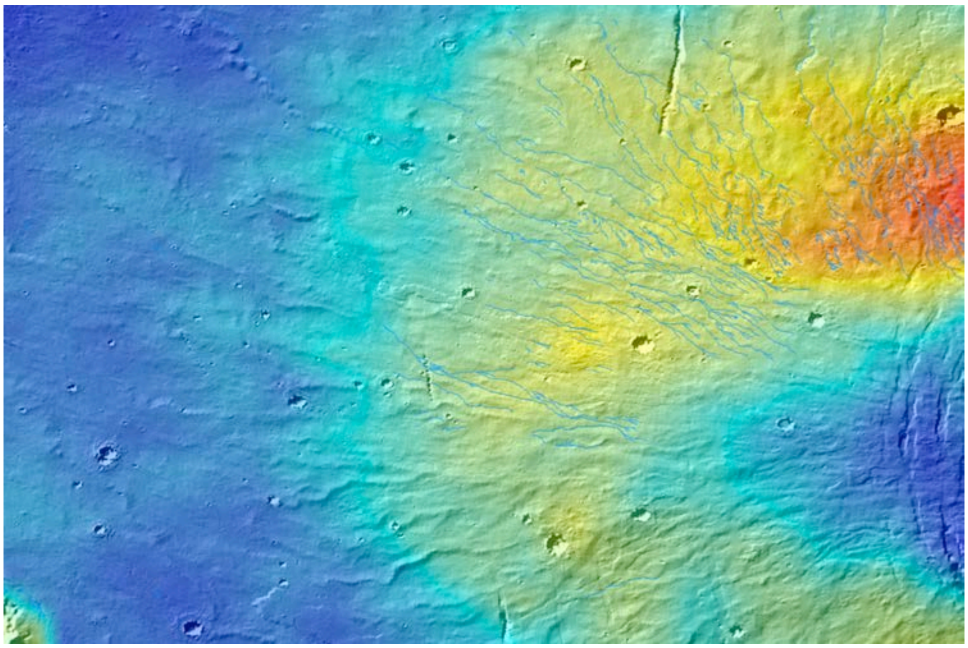

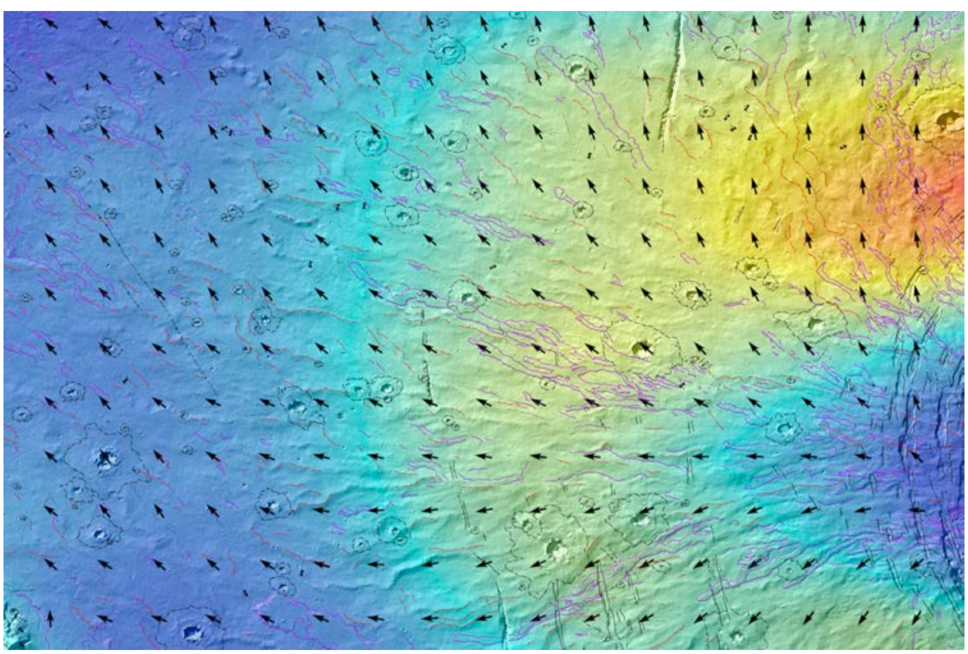

Figure 1. Western Flank of Alba Mons. Top) Average slope (25 km MOLA grid) over MOLA hillshade (463 m/pixel) with fluvial valleys in blue. Bottom) Average slope (50 km slope grid) over MOLA hillshade with mapped geologic features and maximum slope direction arrows. Average slopes values are calculated from resampled MOLA topography. Slope magnitudes and directions are calculated using a 3x3 kernel. Slope range is 0 (dark blue) to 2° (red). Figure widths are ~900 km. Note that locations of fluvial valleys are strongly correlated with higher slopes at 25 km scale (top) and that maximum slope values at 50 km scale (arrows) show strong agreement with lava flows (purple) and lava tubes (red) (bottom).